

### III. THE CONCEPT OF FORCE

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IN maintaining that Smart's discussion missed the point of Hertz's work, I too was concerned with a logical issue. It is the logical point of Hertz's work that Smart seems to misjudge. For argument's sake I shall adopt Smart's manner of speaking and start from his concession that force is more like a relation than a quality. My brief mention of Newton's concept of force suggests that he thought of it as more like a quality. The laws of *Principia* are therefore understood by Newton not as definitions of force but as empirical laws. Hertz's merit lies in emphasising the logical point that force is more like a relation. The question of simplicity was mentioned incidentally and I would not insist on it here. Neither does Hertz recommend his methods for astronomical or engineering calculations. He merely contends, and I think

rightly, that his account of the *principles* of mechanics is logically more acceptable than the Newtonian one.

The logical flaw in Newtonian theory is the lack of clarity concerning what is "mere" definition and what is empirical fact. We have a symptom of this flaw in Smart's suggestion that the laws of motion are neither quite empirical nor quite a definition of force, but both and neither. Hertz removes the basis for this fearful alternative by bringing out the required distinction, and so provides a tenable account of the *principles* of mechanics. As far as procedure in science goes, Smart's point is quite correct: depending on what else we know in given circumstances, we use the laws of motion sometimes in one way, sometimes in the other. But the concept of force remains unclear as long as one wants to have it both ways. I shall not here explain how this causes confusion in physics except to say that when we speak of a force acting on a body we should do well to remember that the actual situation is one of interaction between bodies. The form of words "force acts on" is thus misleading, for though we do not say "relation acts on" we do speak of relations between bodies, and Smart's appeal to this form of words only shows that we sometimes *speak* as though force were not a relation.

As for pedagogy, no one suggests that any subject can be taught by laying down definitions—or, I would add, by getting people to talk intelligent jargon. Further, I agree with Smart that physics is not a formalised system. But the complications introduced by unforeseen interferences in experiment do not entail that the terms of physics have no strict definitions. If it is impossible to lay down strict rules on what is to be made of certain occurrences, this means at worst that scientists are not omniscient. But though the facts are complex this does not mean that no strict deduction is possible at all, or that no strict definition can be given. The defining of a term, however, is often the result of enquiry rather than its starting point, and further research may always bring out new properties of the thing defined, and also afford opportunities for making mistakes.

Finally I would stress that I consider "Is force definable or indefinable?" every bit as improper a question as Smart does, though for different reasons. The question is inappropriate because force is not a proper term, and this is essentially the starting point of Hertz's work. On Smart's view of definition as verbal substitution, the question is inappropriate because "force" is not a shorthand word. I endeavoured to show that mere shorthand definition is neither as widespread nor as important as is often thought. In offering a tentative definition of "electron" I merely intended to point out that on that score mathematics is not in any special logical position. Just as one may commit errors about electrons, so also one may about the circle, for instance one might try to square it.

Concerning traditional confusions, there are no grounds for holding that ordinary language is immune. Smart suggests that if language serves its purpose it cannot be confused. But language has no purpose as such, it is people who have purposes, and in pursuing them they will twist everything, including language, to their own ends. It is because it is used not only for stating facts but also for expressing desires that language, even in its ordinary everyday form, is liable to absorb confusions. This is a commonplace in ethics. In physics, the concept of force causes a good deal of confusion, even if, in spite of this, applied science produces all sorts of useful results.

Perhaps what Smart says about definition is after all not altogether at variance with my statements. For I agree that a definition does nothing to indicate the highly complex properties of a thing. I merely insist that any proper term can be defined (in the traditional sense), and in many different ways. But a definition may become inappropriate in the light of further knowledge, or even false in the sense that something was taken for granted in the framing of it which later turns out to be erroneous. Indicative sentences, I agree, need not be true or false, they may be meaningless.